Progress with AIRS for NWP assimilation at ECMWF

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Technical status / plans

- NESDIS/NRT BUFR data in to OBB (via OBSPROC)
- RTTOV(M) installed in IFS to process AIRS
- Level-1C assimilation elements extended to AIRS
- end-to-end 3D/4D Var testing complete
- New AIRS/IASI monitoring tools developed
- Ingest AIRS BUFR with PREODB
- Investigate timings for monitoring / assimilation

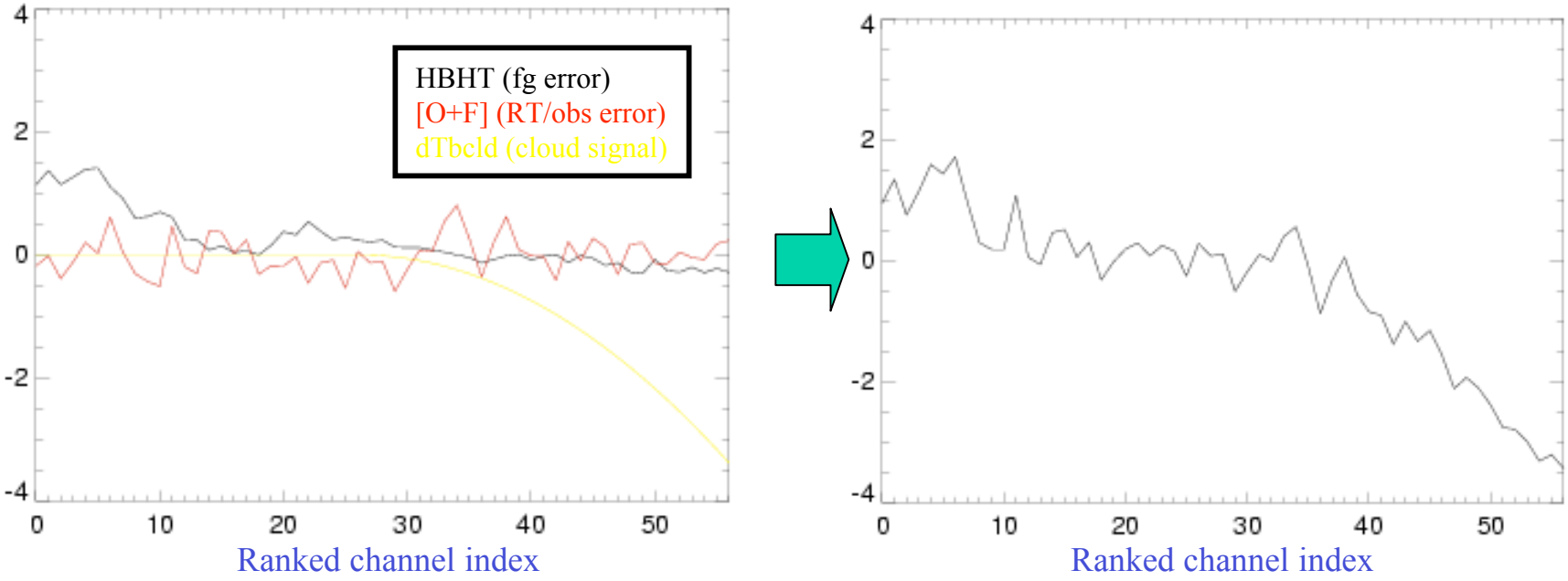
Scientific status / plans

- RTTOV(M) compared to NESDIS / UMBC AIRS RT
- Limited evaluation of EOF data compression
- Vertical structure functions v sensitivity correlations
- Cloud correlation with sensitive areas established
- day-1 detection of clear channels in progress
- Investigate recovery of key features with clear channels
- Review day-1 channel selection in light of cloud detection

Cloud detection by pattern recognition

The difference between observed cloudy radiances and clear-sky radiances computed from a NWP first-guess is a superposition of 3 distinct components

- First-guess (forecast) error mapped in to radiance space (HBH^T)
- Radiometric (instrument) and RT model error (O+F)
- The cloud radiance signal (clear minus cloudy) (Rclr-Rcld)

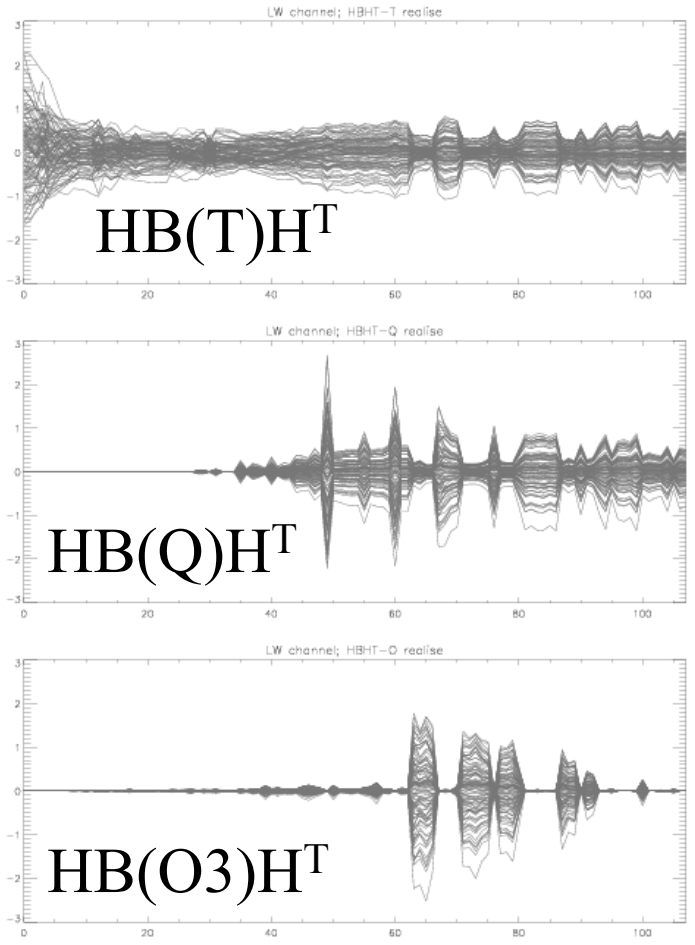


What do we know about the forecast error signal ?

• We have models of T/Q/O3 error that can be mapped in to radiance space

•We have routine statistics from our operational monitoring of AMSUA and HIRS clear data

• The longwave part of the spectrum is the most difficult due to the correlation of T/Q/O3 errors.



What do we know about the instrument/RT error signal ?

- We know the instrument noise - it should be uncorrelated unless calibration errors are important

- We know fast model error is small and correlated in a known way between channels

- We are not sure about LBL model error/ instrument spectral characterization

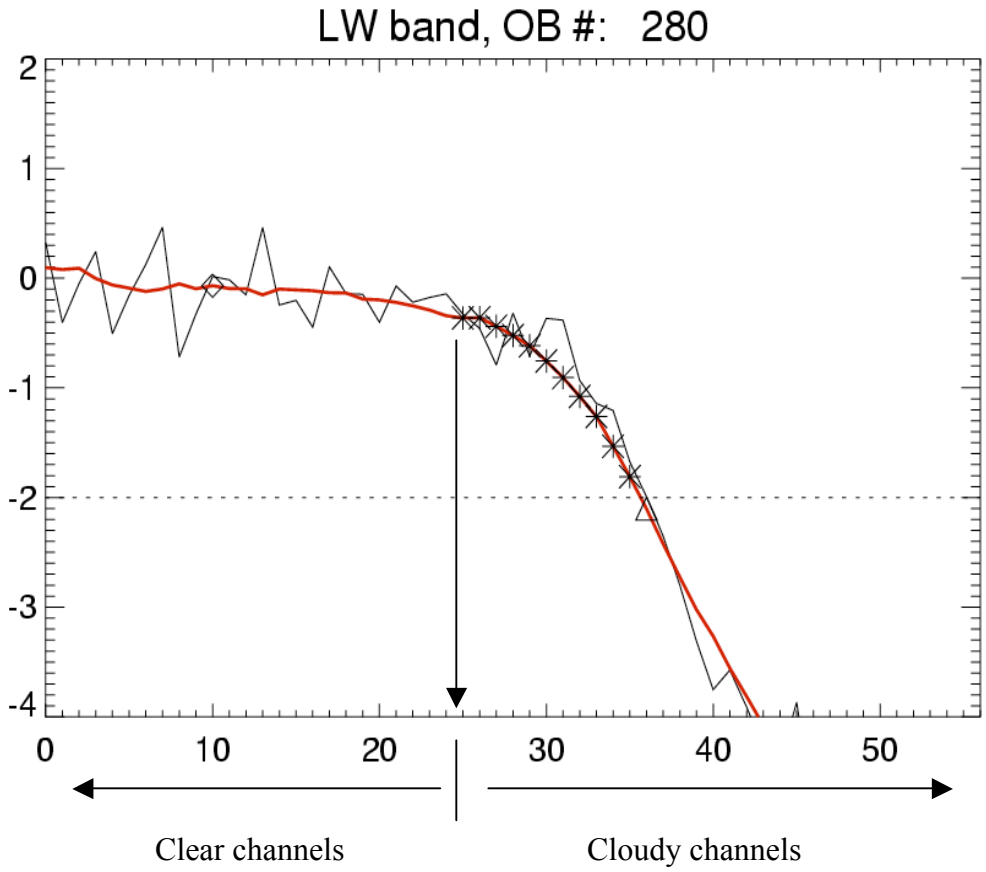
What do we know about the cloud signal ?

- Over warm surfaces (non-frozen) it is always negative

•In band split / ranked channels it increases monotonically negative

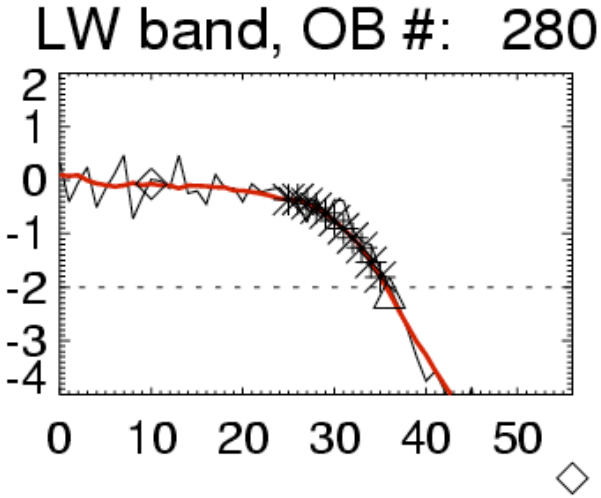
•We can identify an "obviously" contaminated channel and step backwards with a digital filter to locate the first channel with discernable cloud contamination

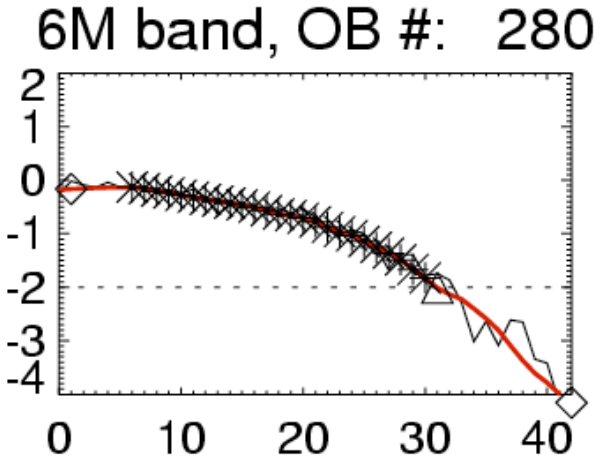
•All channels ranked as higher peaking can safely be assimilated as clear

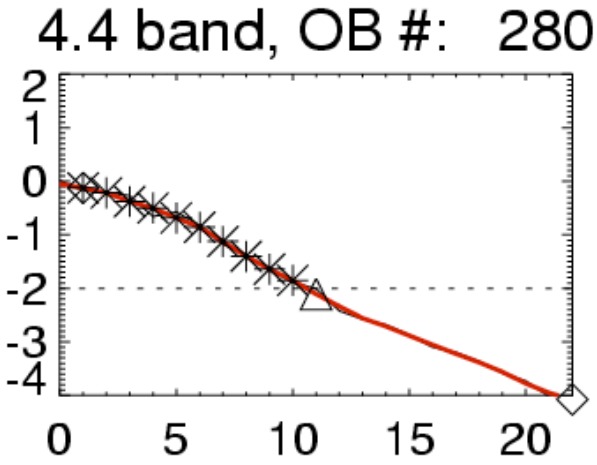


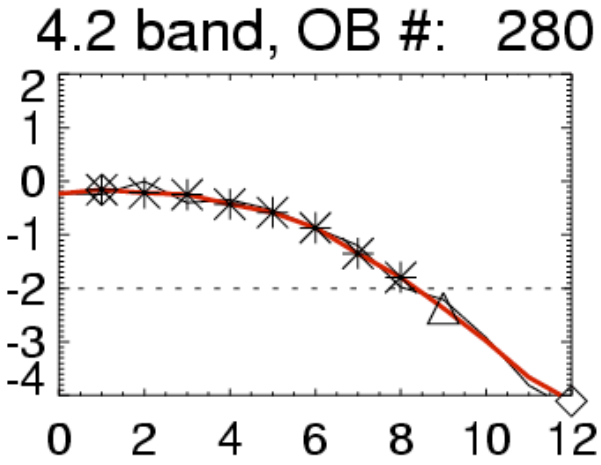
AIRS Channel ranking

– Channel dBTs: ranked - detection by filter









What does the digital filter do?

From our statistical knowledge of

a) radiometric noise covariance
b) forecast radiance error covariance (T/Q/O3)

We create a filter to separate the above from the cloud radiance signal. Two different filters have been tested so far

a) Empirically tuned “low-pass” filter

b) Objective Chi-squared filter using explicit forecast error covariances

AIRS Cloud detection

– Filter detection: index of lowest cloud-free channel